

## IMPROVEMENTS IN AND RELATING TO CONSTRUCTION MATERIALS

### TECHNICAL FIELD

This invention relates to an improved construction material.

### BACKGROUND ART

The present invention relates to an improved construction material, and in particular, to a material which may have a variety of uses within the construction industry.

In the present specification, the word "construction" is intended to denote any activity whereby materials are combined to build objects or structures not previously present. For example, the word "construction" is intended to encompass the fields of masonry, building, concrete mixing and laying, roofing, partitioning, and many other fields.

In addition, in the present specification, the term "concrete mix" will be used to denote the mixture used to form concrete or concrete objects, before the concrete (or concrete object) has set. Many embodiments of the present invention will involve concrete mixes using part-standard, part-novel constituents.

In particular, one of the primary uses of the present invention is envisaged to be in the formation of a novel concrete mix. This concrete mix may subsequently be used for a variety of purposes, for instance in the construction of concrete, pathways, driveways etc, or in the moulding of lightweight concrete blocks for building (and other) construction, or for a variety of other uses. Concrete produced in accordance with the present invention may also be used for roofing, furnace or kiln construction,

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Priority Date(s):	7/11/95
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Complete Specification Filed: 23/12/96	
Class: (6) C04B 14/00; C04B 20/00;	
..... C04B 7/02	
.....	
Publication Date:	24 JUN 1997
P.O. Journal No:	1417

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COMPLETE SPECIFICATION**

**PATENTS FORM NO. 4**

Appln Fee: \$80.00

**PATENTS ACT 1953**  
**PROVISIONAL SPECIFICATION**

**IMPROVEMENTS IN AND RELATING TO CONSTRUCTION  
MATERIALS**

I/WE William Richard Milburn Farland, a New Zealand citizen of  
165 Kerikeri Road, Kerikeri, New Zealand  
do hereby declare this invention to be described in the following  
statement:

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outdoor furniture or benches, partitioning screens, or for many other uses.

For simplicity, in the majority of the present specification we will discuss the use of the present invention in relation to the construction of building blocks for use in building objects such as homes or offices. However, it should be appreciated that this discussion is for illustrative purposes only, and is not intended to limit the scope of the present specification in any way.

Currently, there exists a number of difficulties involved in the construction of homes using standard concrete building blocks. For example, concrete blocks as are commonly used in the construction of homes are usually quite heavy, and may also have low thermal resistance. The use of heavy concrete building blocks in home construction necessitates the use of strengthening material, such as reinforcing steel, lining, panelling, strapping or other materials to support the weight of the concrete. The installation of the strengthening materials is often time consuming and relatively expensive.

Furthermore, heavy concrete blocks are often more susceptible to damage during an event such as an earthquake. Heavy blocks, in particular, tend to behave in a "rigid" manner when subject to lateral stresses which may be incurred during (say) an earthquake. As a result, the heavy vertical loading on these blocks often causes splitting or shattering of the block, leading to damage of the building in which the block is a part. A reasonably lightweight concrete block would have the considerable advantage that the reduced reinforcing needed to support this block would assist in the block behaving in a more "elastic" manner during an earthquake, which reduces the risk of damage during an earthquake.

In addition, present concrete blocks suffer from the disadvantage that frequently these blocks have low thermal resistance. This leads to the disadvantage that heat flow through the walls that the blocks form may take place reasonably easily, leading to considerable heat loss from within the house. Furthermore, problems such as moisture travelling across the blocks, both into and out of the house, can lead to damage in the wall itself, further compromising the integrity of the house. A concrete block that included a relatively high thermal resistance (compared to usual heavy concrete blocks) would have the considerable advantage that temperature control within the house would be considerably easier, and there would be less likelihood of damage to the walls that the blocks comprise. Furthermore, the usual requirement of providing panelling or other insulation to house walls due to the low thermal resistance of standard concrete blocks, could also be reduced by using concrete blocks with higher thermal resistance. This would result in considerable time and money savings to both the builder, and the house owner.

It is an object of the present invention to address the foregoing problems or at least to provide the public with a useful choice.

Further aspects and advantages of the present invention will become apparent from the ensuing description which is given by way of example only.

DISCLOSURE OF INVENTION

According to one aspect of the present invention there is provided a construction material formed from a mixture including cement, at least one aggregate material, and an admixture, the cement to aggregate material ratio being in the range 4-10 parts aggregate to one part cement, the admixture comprising any material or materials capable of strengthening the construction material.

According to a further aspect of the present invention there is provided a construction material formed from a mixture including cement, at least one aggregate material, and an admixture, the cement to aggregate material ratio being in the range of 4-10 parts aggregate to one part cement, the admixture comprising any material or materials capable of strengthening the construction material and comprising between 5 and 30% of the weight of the cement.

According to a further aspect of the present invention there is provided a construction material formed from a mixture including cement, at least one aggregate material, and an admixture, the aggregate material substantially comprising a volcanic glass, and added to the cement in a ratio of between 4 and 10 parts aggregate to one part cement, the admixture including microsilica and comprising between 5 and 30% of the weight of the cement, the admixture further including a substance or substances assisting the microsilica to bond to the cement or to otherwise strengthen the construction material.

In preferred embodiments of the present invention, it is envisaged that the cement used in the construction material may be any standard cement, such as Portland cement, or Calcium Aluminate cement. In particular, as Portland cement is by far the most commonly used cement in most areas of the construction industry, this shall be used in most embodiments of the present invention.

Although a variety of aggregate materials may be used in preferred embodiments of the present invention, the applicant has discovered that use of volcanic glasses such as expanded rhyolites (also known as perlite), obsidian, or vermiculite, as well as other volcanic glasses, may be particularly appropriate for use in the present invention. These volcanic glasses, together with other materials, are collectively known in most areas of the construction industry as "lightweight aggregates", and may significantly reduce the weight of concrete mixes made from them. In particular, the present invention is envisaged to produce a construction material which when forming substances such as concrete blocks, may reduce the weight of the concrete block by up to 50% of its standard weight. This has considerable advantages, which are discussed later in the present specification.

Although any aggregate to cement ratio within the above stated 4-10 parts aggregate to one part cement range may be used, preferred embodiments of the present invention may have an aggregate to cement ratio of 6-8 parts aggregate to one part cement. The actual ratio used will depend on the final use of the concrete mix, the type of aggregate used, the composition of the admixture added to the mix, and other factors.

forming substances such as concrete blocks, may reduce the weight of the concrete block by up to 50% of its standard weight. This has considerable advantages, which are discussed later in the present specification. Compressive strength is also increased by up to 25%, whilst maintaining low density.

Although any aggregate to cement ratio within the above stated 4-10 parts aggregate to one part cement range may be used, preferred embodiments of the present invention may have an aggregate to cement ratio of 6-8 parts aggregate to one part cement. The actual ratio used will depend on the final use of the concrete mix, the type of aggregate used, the composition of the admixture added to the mix, and other factors.

In a preferred embodiment the lightweight aggregate may be treated to strengthen the construction of same. Said treatment may comprise predrying and/or preheating of the lightweight aggregate.

In an alternative embodiment aggregate fines may be removed and replaced with a component of particulate material, such as sand. This provides a coarse expanded lightweight aggregate and sand aggregate material exhibiting improved compressive strength.

In further embodiments of the present invention, an admixture comprising a number of substances may be added to the cement and aggregate mixture. This admixture may be used to modify the properties of the construction material in order to make it more suitable for use in the construction industry. For example, the strength, weight, thermal resistance, compressive strength, lateral stress resistance, and many other properties of the concrete mix (or subsequent concrete objects) will usually be positively affected by the addition of a suitable admixture.

In still further preferred embodiments of the present invention, the weight of the microsilica added to the construction material may be approximately 15% of the cement content. However, it should also be appreciated that other amounts of microsilica may also be used, and in particular any amount of microsilica between approximately 5 to 30% of the cement weight may be added to the concrete mix.

Although the addition of microsilica to the concrete mix may have a number of advantages in the present invention, the applicant has found that to enhance the properties of the resultant construction material, further substance or substances may also be beneficial to add to the concrete mix. For example, small amounts of material such as a surfactant based plasticiser, either by itself, or preferably in combination with a Beta Naphthalene Sulphonate may be added to the microsilica, cement and aggregate mix to assist in the dispersion of the microsilica and cement within the concrete mix, and to facilitate the mixing of the microsilica and later bonding of the cement and microsilica to each other. The addition of these extra substances also provides a greater surface area for hydration to occur during the mixing process of the concrete mix, and can considerably increase (by up to, or more than 20%) the strength of the resulting construction material.

Furthermore, in addition to a surfactant based plasticiser or Beta Naphthalene Sulphonate, further admixtures may also be added to the concrete mix, for example, a sealant such as a methyl resin emulsion may be sprayed onto the aggregate at any time before the construction material is formed. This may assist in controlling the water demand of

the aggregates used in the present invention. Other substances, such as fibre reinforcements may also be added to the concrete mix, as part of the admixture, as may substances such as sand, which primarily acts as a filler.

In the applicant's experience, the addition of the abovementioned substances in combination with microsilica has not previously been performed when making concrete or similar articles which may be used as construction materials, and the addition of these substances forms one of the main inventive concepts of the present invention.

In order to produce an object (such as a concrete block) from the concrete mix described above, in a preferred embodiment of the present invention, the following process and amount of materials may be used:

Cement	320 kg
Expanded Rhyolite or Obsidian	2000 litres (6.25 to 1 ratio with cement)
Sand	100 litres
Microsilica	50 kg (15% of cement content)
"Proprietary Admixture"	2.4 litres
Water	300 litres (this may vary if appropriate)

The expanded rhyolite or obsidian will preferably be able to pass the following sieve analysis;

6.70 mm	0%
4.75 mm	2%
4.00 mm	6%
2.80 mm	17%
2.36 mm	25%
2.00 mm	30%
1.18 mm	43%
0.60 mm	55%
0.30 mm	73%
0.15 mm	88%
pan	100%
Loose bulk density (kg/m <sup>3</sup> )	150-200

The "Proprietary admixture" may comprise a number of materials, but is envisaged to include a combination plasticiser, wetting agent, and dispersant designed to facilitate the thorough mixing of the microsilica into the concrete mix. This is important in most embodiments of the present invention as many processes leading to the formation of construction materials require that the concrete mix be unusually dry, in order to achieve the low density which many embodiments of the present invention have. The proprietary admixture may preferably include materials previously discussed, such as a surfactant based plasticiser, Beta Naphthalene Sulphonates, as well as other materials such as sealers or reinforcing materials.

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To produce the concrete block, the aggregate may be mixed for two to three minutes (compared to the normal mixing time for standard concrete blocks of 10 minutes), and all dry ingredients placed in a paddle mixer and pre-blended for approximately 30 seconds. The water and admixture may then be added to allow for a final trim prior to entering a standard block making machine, such as a Colombia 1600 (TM) four block machine. The material may be steam cured in this machine for approximately 12 hours.

By using the concrete mix as described above it should be appreciated that a relatively lightweight concrete block may be produced which has a relatively high thermal resistance. For example, a 150 Series block formed using the exemplary mixture outlined above, may have an R value of .66m<sup>2</sup> c/w and a block density of 784 kg/m<sup>3</sup> dry. And at 784 kg/m<sup>3</sup> dry density, the preferred block may have a compressive strength between approximately 1414 and 2241 Kpa.

Thus it should be appreciated that the present invention allows a relatively low density yet strong concrete block having a relatively high thermal resistance to be constructed.

The applicant has found that a concrete block made from this concrete mix may have a number of advantages over present concrete blocks.

These advantages include (but are not limited to):

- (1) A substantial reduction in the weight of the concrete block, and frequently a reduction of approximately 50% in the weight of the concrete block. These blocks are easier to handle in building and construction, and also reduce the weight of the walls made from these blocks, reducing their seismic loads, and making these walls more earthquake stable. In addition, the lighter blocks also reduce the amount of reinforcing needed in these walls, reducing cost and labour time.
- (2) Larger block sizes are able to be produced with this construction material, as the weight of the material is less. These larger blocks assist in speeding up the laying process when constructing buildings.
- (3) Concrete blocks made from the above process are usually softer than standard concrete blocks, allowing the block to be easily cut by tools which do not cut standard concrete blocks.
- (4) The resultant concrete block may be stronger than conventional concrete blocks, and strength increases of 20% are reasonably typical for the present invention.
- (5) The thermal resistance of the concrete block produced by the present invention can be considerably greater than those of conventional concrete blocks. This overcomes many of the problems that were also discussed in the prior art.

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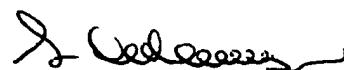
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It should be appreciated that the above example is just one illustration of the use of the present invention to make a concrete block, and differing amounts and combinations of materials, and different mixing processes may also be used in constructing concrete blocks.

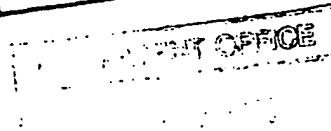
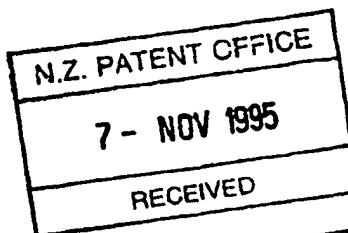
Aspects of the present invention have been described by way of example only and it should be appreciated that modifications and additions may be made thereto without departing from the scope thereof.

William Richard Milburn Farland  
by his Attorneys



JAMES & WELLS

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**PATENTS FORM NO. 5**

Fee No. 4: \$260.00

**PATENTS ACT 1953**

**COMPLETE SPECIFICATION**

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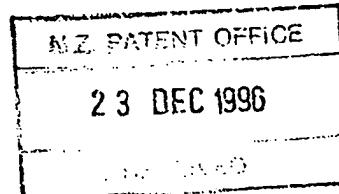
No. 280409

Dated: 7 November 1995

**IMPROVEMENTS IN AND RELATING TO CONSTRUCTION  
MATERIALS**

I William Richard Milburn Farland, a New Zealand citizen of  
165 Kerikeri Road, Kerikeri, New Zealand

hereby declare the invention for which I pray that a patent may be  
granted to me, and the method by which it is to be performed to be  
particularly described in and by the following statement:



## IMPROVEMENTS IN AND RELATING TO CONSTRUCTION MATERIALS

### TECHNICAL FIELD

This invention relates to improved construction materials and methods.

### BACKGROUND ART

The present invention relates to an improved construction material and methods envisaged particularly but not solely applicable to monolithic construction.

Traditional grey masonry is laid on a horizontal plane in a 0.400x0.200 module. This a well established construction method, however its suitability for use in residential and light commercial structures is questionable. Standard 200 series masonry units withstand compressive loads of 56 tonnes, suggesting the unit is over engineered for many applications. The weight of the unit creates deadload within the structure requiring considerable steel work to support it.

Lightweight masonry units for residential and low level structures are preferable because of savings in site labour, weight and an improved thermal performance. Lightweight aggregate used in lightweight masonry is primarily open surfaced expanded rhyolite, more commonly known as perlite. It shall be hereinafter referred to as same.

It would be desirable to use lightweight aggregate in an improved cement. It would also be desirable to use lightweight aggregate in the manufacture of lightweight precast panels, reducing site labour in monolithic construction.

In the present specification, the word "construction" is intended to denote any activity whereby materials are combined to build objects or structures not previously present. For example, the word "construction" is intended to encompass the fields of masonry, building, concrete mixing and laying, roofing, partitioning, and many other fields.

In addition, in the present specification, the term "concrete mix" will be used to denote the mixture used to form concrete or concrete objects, before the concrete (or concrete object) has set. Many embodiments of the present invention will involve concrete mixes using part-standard, part-novel constituents.

In particular, one of the primary uses of the present invention is envisaged to be in the formation of a novel concrete mix. This concrete mix may subsequently be used for a variety of purposes, for instance in the construction of pre cast panels and "tilt up" construction, etc, or in the moulding of lightweight concrete blocks for building (and other) construction, or for a variety of other uses. Concrete produced in accordance with the present invention may also be used for roofing, furnace or kiln construction, outdoor furniture or benches, partitioning screens, or for many other uses.

For simplicity, in the majority of the present specification we will discuss the use of the present invention in relation to the construction of building blocks for use in building objects such as homes or offices. However, it should be appreciated that this discussion is for illustrative purposes only, and is not intended to limit the scope of the present specification in any way.

Currently, there exists a number of difficulties involved in the construction of homes using standard concrete building blocks. For example, concrete blocks as are commonly used in the construction of homes are usually quite heavy, and may also have low thermal resistance. The use of heavy concrete building blocks in home construction necessitates the use of strengthening material, such as reinforcing steel, lining, panelling, strapping or other materials to support the weight of the concrete. The installation of the strengthening materials is often time consuming and relatively expensive.

Furthermore, heavy concrete blocks are often more susceptible to damage during an event such as an earthquake. Heavy blocks, in particular, tend to behave in a "rigid" manner when subject to lateral stresses which may be incurred during (say) an earthquake. As a result, the heavy vertical loading on these blocks often causes splitting or shattering of the block, leading to damage of the building in which the block is a part. A reasonably lightweight concrete block would have the considerable advantage that the reduced reinforcing needed to support this block would assist in the block behaving in a more "elastic" manner during an earthquake, which reduces the risk of damage during an earthquake.

In addition, present concrete blocks suffer from the disadvantage that frequently these blocks have low thermal resistance. This leads to the disadvantage that heat flows through the blocks reasonably easily, leading to considerable heat loss from within the house. Furthermore, problems such as moisture travelling across the blocks, both into and out of the house, can lead to damage in the wall itself, further compromising the integrity of the house. A concrete block that included a relatively high thermal resistance (compared to usual heavy concrete blocks) would

have the considerable advantage that temperature control within the house would be considerably easier, and there would be less likelihood of damage to the walls that the blocks comprise. Furthermore, the usual requirement of providing panelling or other insulation to house walls due to the low thermal resistance of standard concrete blocks, could also be reduced by using concrete blocks with higher thermal resistance. This would result in considerable time and money savings to both the builder, and the house owner.

It is an object of the present invention to address the foregoing problems or at least to provide the public with a useful choice.

Further aspects and advantages of the present invention will become apparent from the ensuing description which is given by way of example only.

#### DISCLOSURE OF INVENTION

According to one aspect of the present invention there is provided a construction material formed from a mixture including cement, at least one lightweight aggregate material, as hereinbefore defined and an admixture, the cement to aggregate material ratio being in the range 4-10 parts aggregate to one part cement, the admixture comprising any material or materials capable of strengthening the construction material.

According to a further aspect of the present invention there is provided a construction material formed from a mixture including cement, at least one lightweight aggregate material, and an admixture, the cement to aggregate material ratio being in the range of 4-10 parts aggregate to one part cement, the admixture comprising any material or materials capable of

strengthening the construction material and comprising between 5 and 30% of the weight of the cement.

According to a further aspect of the present invention there is provided a construction material formed from a mixture including cement, at least one aggregate material, and an admixture, the aggregate material substantially comprising a volcanic glass, and added to the cement in a ratio of between 4 and 10 parts aggregate to one part cement, the admixture including microsilica and comprising between 5 and 30% of the weight of the cement, the admixture further including a substance or substances assisting the microsilica to bond to the cement or to otherwise strengthen the construction material.

In preferred embodiments of the present invention, it is envisaged that the cement used in the construction material may be any standard cement, such as Portland cement, or Calcium Aluminate cement. In particular, as Portland cement is by far the most commonly used cement in most areas of the construction industry, this shall be used in most embodiments of the present invention.

Although a variety of aggregate materials may be used in preferred embodiments of the present invention, the applicant has discovered that use of volcanic glasses such as expanded rhyolites (also known as perlite), obsidian, or vermiculite, as well as other volcanic glasses, may be particularly appropriate for use in the present invention. Zeolite may also prove suitable in some applications. Volcanic glasses, together with other materials, are collectively known in most areas of the construction industry as "lightweight aggregates", and may significantly reduce the weight of concrete mixes made from them. In particular, the present invention is envisaged to produce a construction material which when

forming substances such as concrete blocks, may reduce the weight of the concrete block by up to 50% of its standard weight. This has considerable advantages, which are discussed later in the present specification. Compressive strength is also increased by up to 25%, whilst maintaining low density.

Although any aggregate to cement ratio within the above stated 4-10 parts aggregate to one part cement range may be used, preferred embodiments of the present invention may have an aggregate to cement ratio of 6-8 parts aggregate to one part cement. The actual ratio used will depend on the final use of the concrete mix, the type of aggregate used, the composition of the admixture added to the mix, and other factors.

In a preferred embodiment the lightweight aggregate may be treated to strengthen the construction of same. Said treatment may comprise predrying and/or preheating of the lightweight aggregate.

In an alternative embodiment aggregate fines may be removed and replaced with a component of particulate material, such as sand. This provides a coarse expanded lightweight aggregate and sand aggregate material exhibiting improved compressive strength.

In further embodiments of the present invention, an admixture comprising a number of substances may be added to the cement and aggregate mixture. This admixture may be used to modify the properties of the construction material in order to make it more suitable for use in the construction industry. For example, the strength, weight, thermal resistance, compressive strength, lateral stress resistance, and many other properties of the concrete mix (or subsequent concrete objects) will usually be positively affected by the addition of a suitable admixture.

Although a variety of admixtures may be used, the applicant has found that the addition of microsilica and/or silica fume to the cement and aggregate mixture can have considerable benefits for the resulting concrete object. In particular, microsilica (especially in powder form), when added to standard concrete mixes, generally increases both the durability and strength of the concrete mix, as well as reducing permeability of the concrete and improving abrasion-erosion resistance.

In addition, when powdered microsilica is added to the concrete mixes such as those described in the present specification, the particles of microsilica are able to fill the voids between the cement particles, improving the packing of the cement and creating a less permeable concrete structure. Microsilica can also assist the bonding of the cement particles to other particles in the cement and aggregate mix, thus increasing the strength of the resulting construction material.

In still further preferred embodiments of the present invention, the weight of the microsilica and/or silica fume added to the construction material may be approximately 15% of the cement content. However, it should also be appreciated that other amounts of microsilica may also be used, and in particular any amount of microsilica between approximately 5 to 30% of the cement weight may be added to the concrete mix.

Although the addition of microsilica to the concrete mix may have a number of advantages in the present invention, the applicant has found that to enhance the properties of the resultant construction material, further substance or substances may also be beneficial to add to the concrete mix. For example, small amounts of material such as a surfactant based plasticiser, either by itself, or preferably in combination

with a Beta Naphthalene Sulphonate may be added to the microsilica, cement and aggregate mix to assist in the dispersion of the microsilica and cement within the concrete mix, and to facilitate the mixing of the microsilica and later bonding of the cement and microsilica to each other. The addition of these extra substances also provides a greater surface area for hydration to occur during the mixing process of the concrete mix, and can considerably increase (by up to, or more than 20%) the strength of the resulting construction material.

Furthermore, in addition to a surfactant based plasticiser or Beta Naphthalene Sulphonate, further admixtures may also be added to the concrete mix, for example, a sealant such as a methyl resin emulsion may be sprayed onto the aggregate at any time before the construction material is formed. This may assist in controlling the water demand of the aggregates used in the present invention. Other substances, such as fibre reinforcements such as polypropylenes, acrylics and ceramic fibre for refractory concrete may also be added to the concrete mix, as part of the admixture, as may substances such as sand, which primarily acts as a filler.

Accordingly, in yet a further aspect of the present invention, aggregate materials may be sealed to obviate the tendency of same to absorb water during batching. Sealed aggregate reduces the water demand and renders more added water available for cement hydration, thereby improving batching consistency and finished strength of the cement.

The sealant may preferably be a proprietary silicone/seloxane sealer although any suitable sealer may be used.

In the applicant's experience, the addition of the abovementioned substances in combination with microsilica has not previously been performed when making concrete or similar articles which may be used as construction materials, and the addition of these substances forms one of the main inventive concepts of the present invention. The microsilica in the curing process also reacts with free Ca(OH)<sub>2</sub> in the cement to form additional calcium silicate hydrate, enhancing the bond with the aggregate.

In order to produce an object (such as a concrete block) from the concrete mix described above, in a preferred embodiment of the present invention, the following process and amount of materials may be used:

Cement	320 kg
Expanded Rhyolite or Obsidian	2000 litres (6.25 to 1 ratio with cement)
Sand	100 litres
Microsilica	50 kg (15% of cement content)
"Proprietary Admixture"	2.4 litres
Water	300 litres (this may vary if appropriate)

The expanded rhyolite or obsidian will preferably be able to pass the following sieve analysis;

6.70 mm	0%
4.75 mm	2%
4.00 mm	6%
2.80 mm	17%
2.36 mm	25%
2.00 mm	30%
1.18 mm	43%
0.60 mm	55%
0.30 mm	73%
0.15 mm	88%
pan	100%
Loose bulk density (kg/m <sup>3</sup> )	150-200

As noted above, the fine material (substantially 0.6 - 0.15 mm may instead be replaced with particulate material such as sand.

The "Proprietary admixture" may comprise a number of materials, but is envisaged to include a combination plasticiser, wetting agent, and dispersant designed to facilitate the thorough mixing of the microsilica into the concrete mix. This is important in most embodiments of the present invention as many processes leading to the formation of construction materials require that the concrete mix be unusually dry, in order to achieve the low density which many embodiments of the present invention have. The proprietary admixture may preferably include materials previously discussed, such as a surfactant based plasticiser,

Beta Naphthalene Sulphonates, as well as other materials such as sealers, reinforcing materials, air entrains and foamed recycled plastics.

To produce the concrete block, in accordance with still another aspect of the present invention the aggregate may be mixed for two to three minutes (compared to the normal mixing time for standard concrete blocks of 10 minutes), and all dry ingredients placed in a paddle mixer and pre-blended for approximately 30 seconds. The water and admixture may then be added to allow for a final trim prior to entering a standard block making machine, such as a Colombia 1600 (TM) four block machine. The material may be steam cured for approximately 12 hours.

By using the concrete mix as described above it should be appreciated that a relatively lightweight concrete block may be produced which has a relatively high thermal resistance. For example, a 150 Series block formed using the exemplary mixture outlined above, may have an R value of  $.66\text{m}^2 \text{c/w}$  and a block density of  $784 \text{ kg/m}^3$  dry. And at  $784 \text{ kg/m}^3$  dry density, the preferred block may have a compressive strength between approximately 1414 and 2241 Kpa.

Thus it should be appreciated that the present invention allows a relatively low density yet strong concrete block having a relatively high thermal resistance to be constructed.

The applicant has found that a concrete block made from this concrete mix may have a number of advantages over present concrete blocks. These advantages include (but are not limited to):

- (1) A substantial reduction in the weight of the concrete block, and frequently a reduction of approximately 50% in the weight of the concrete block. These blocks are easier to handle in building and construction, and also reduce the weight of the walls made from these blocks, reducing their seismic loads, and making these walls more earthquake stable. In addition, the lighter blocks also reduce the amount of reinforcing needed in these walls, reducing cost and labour time.
- (2) Larger block sizes are able to be produced with this construction material, as the weight of the material is less. These larger blocks assist in speeding up the laying process when constructing buildings.
- (3) Concrete blocks made from the above process are usually softer than standard concrete blocks, allowing the block to be easily cut by tools which do not cut standard concrete blocks.
- (4) The resultant concrete block may be stronger than conventional perlite blocks, and strength increases of 25% are reasonably typical for the present invention.
- (5) The thermal resistance of the concrete block produced by the present invention can be considerably greater than those of conventional concrete blocks. This overcomes many of the problems that were also discussed in the prior art.

It should be appreciated that the above example is just one illustration of the use of the present invention to make a concrete block, and differing amounts and combinations of materials, and different mixing processes

may also be used in constructing concrete blocks. Differing methods of exfoliation are also within the scope of the present invention.

According to yet a further aspect of the present invention there is provided a panel for use in masonry construction characterised in that it is precast.

Preferably the precast panels may be adapted to be vertically joined together thereby forming a structure.

Preferably the precast panels are of a size such that they may be joined to create larger structural panels equivalent to 12 laid conventional concrete blocks (2.400 x .400). However, the precast panels may be of any dimension considered suitable.

The panels may be of any form considered suitable but in a preferred embodiment may be substantially rectangular having protuberances therefrom in an arrangement such that when two panels are in use aligned facing each the protuberances meet, thereby forming a composite panel.

It will be appreciated that a composite panel may exhibit a honeycombed interior. This is advantageous in being able to receive structural supports, such as steel reinforcing rods.

Corners of walls made from the composite panels may accordingly be connected by a device according to a further aspect of the present invention adapted to span cavities, connecting same. The device may preferably comprise a vertical central portion adapted to be positioned in or span the body of adjacent panels with horizontal members supported thereupon adapted to be positioned in the cavities of adjacent panels,

preferably attaching to vertical steel rods in the cavities. However, any other device capable of connecting the panels may be used for the purposes of the present invention.

A bonding agent such as mortar may be applied to the protuberances such that when two panels are so aligned they are thereby joined together to form a two part panel, hereinafter termed a composite panel. However, it should be appreciated that the present method need not employ composite panels.

In a preferred embodiment the panels may be adapted to enable engagement with each other when aligned side by side. Such adaptation may comprise a male member being provided at part or the entire length of one side of a panel and a female member being provided at the opposite side such that in use interlocking is enabled. However, any other means of engaging panels is within the scope of the present invention.

The male and/or female members may be coated with a bonding agent such as caulking to facilitate interlocking. It will be appreciated that caulking is particularly advantageous in permitting movement during construction, but will then set semi-hard.

Preferably the larger panels are of a size such that they may be joined together on site to create the full height of a wall in one operation. It is envisaged that each larger panel may weigh approximately 70 kg, obviating the need for a crane to lift same into position.

The panels may be adapted so that completed walls may be reinforceable with steel in the traditional manner eg by passing vertically through the honeycombed interior..

Another panel according to the present invention may be a structural non composite panel. That is, they are not envisaged for use in two part construction. Whilst they may be adapted to laterally and vertically engage with each when aligned, these panels are characterised in being of substantially solid construction and may be reinforced with steel mesh.

According to a further aspect of the present invention there is provided a non structural panel for use in masonry construction. As used herein, non structural means non load bearing, or partitioning.

It is envisaged that such non structural panels may be thinner than the above described structural panels, and would not be reinforced with steel. Sides may be joined together with rubberised adhesive and overlaid with fibreglass tape. Proprietary products such as Ramset™ nails may join the panels.

The non structural panels would preferably be adapted to enable utilities to be easily passed therethrough, such as having honeycombed cavities. Alternatively, they may simply be drilled through.

The non structural panels may form partitions, and be finished eg with plaster, in the usual manner.

It will be appreciated that panels may be cut on site in the structural and non structural panels to form openings such as required for doors and windows.

According to a further aspect of the present invention there is provided a method of masonry construction comprising the steps of:

- (a) providing one or more panels as hereinabove disclosed
- (b) joining same together to form a structure

characterised in that the panels are precast and enable formation of the structure on site.

#### BRIEF DESCRIPTION OF DRAWINGS

Further aspects of the present invention will become apparent from the ensuing description which is given by way of example only and with reference to the accompanying drawings in which:

- Figure 1 is a top plan view of structural panels according to one aspect of the present invention;
- Figure 2 is a top plan view of the structural panels of Figure 1 facing together forming a composite panel;
- Figure 3 is a top plan view of the composite panel of Figure 2 aligned side by side forming a cornered wall;
- Figure 4 is a perspective view of a connecting device according to a further aspect of the present invention;
- Figure 5 is a standing half structural panel according to a further aspect of the present invention;
- Figure 6 is a composite panel of the half panel shown in Figure 5;

Figure 7 shows side perspective side, top and side plan views of a non structural panel according to a further aspect of the present invention;

Figure 8 shows perspective front, top and side views of a composite non structural panel as shown in Figure 7;

Figure 9 is a top view of a composite non structural panel;

Figure 10 is a perspective view of the view shown in Figure 9;

Figure 11 is a perspective view of a partition wall made from partitioning panels according to one aspect of the present invention;

Figure 12 shows a typical Ramset™ connection of partition walls using panels according to one aspect of the present invention;

Figure 13 is an exploded pictorial view of construction using panels according to another aspect of the present invention;

Figure 14 is a top view of the panels shown in Figure 13 showing mesh reinforcing, and

Figure 15 is a top view of a wall made using the panels shown in Figure 14.

**BEST MODES FOR CARRYING OUT THE INVENTION:**

Referring to Figure 1 there is illustrated a panel generally indicated by the arrow 1 for use in masonry construction characterised in that it is pre-cast.

In this embodiment the panels 1 have protuberances 3 therefrom in an arrangement such that when two panels 1 are in use aligned facing each other the protuberances 3 meet.

Referring to Figure 2 there is a composite (two part) panel generally illustrated by the arrow 5. The junction of two meeting protuberances 3 is indicated by arrow 7. Cavities 9 in the composite panels 5 are also shown.

Referring to Figure 3 there is illustrated the composite panels 5 aligned side to side to form a cornered structural wall. A device generally indicated by arrow 11 adapted to span cavities 9 in the composite panels 5 is shown. Reinforcing steel rods 6 are illustrated in some cavities 9.

The device 11 may in one embodiment comprise a central position 13 adapted to be positioned in the body of adjacent composite panels 5, for example by a saw line being cut down for insertion of the central vertical portion 13. The central vertical portion 13 may support horizontal members 15 adapted to be positioned in the cavities 9. In this embodiment the horizontal members 15 bear perforations 17 enabling insertion upon to vertical steel rods 6, thereby connecting intersecting composite panels 5.

Alternative embodiments of panels according to the present invention are shown in Figures 5 and 6 showing protuberances 3. The adaptation of the sides of the panels to enable engagement side by side are also shown by arrow 19.

Referring to Figure 11 a pictorial view of a partition wall using non structural panels as illustrated in figures 7 - 10 and as disclosed in the present invention is illustrated comprising panels 1, access holes for

services 21, fibreglass tape jointing strip 23, a mortar bed base 25 in which the lower panels 1 are set and a plastered finish to suit 27.

Referring to Figure 12 there is illustrated a typical junction of panels according to one aspect of the present invention showing connection using rubberised adhesive 29 and proprietary Ramset™ nails 31.

Referring to Figure 13 there is illustrated a pictorial exploded view of construction using panels according to a further aspect of the present invention. These panels generally indicated by the arrow 1 are of substantially solid construction, and may be enforced with steel mesh or other reinforcing (not shown) rather than conventional steel reinforcing as may be used in structural panels of the present invention. It can be seen that these panels 1 also are adapted as shown at 19 to enable side to side engagement. It can be seen that the panels 1 are set into a recess 33 at the edge of the floor slab 35. One or more layers of panels 1 are erected and apertures such as window holes 37 may be cut in same. When the desired panel 1 height has been reached a further locating C section 33 is placed at the top of the panels forming a support for roofing shown here by truss 39. It is envisaged that the C section 33 used at the top and bottom of the panels 1 may be proprietary light weight locating steel C sections, preferably 1 to 2 millimetres.

Referring to Figure 14 there is a top view of panels 1 shown in the solid panel construction of Figure 13, showing that the side adaptations 19 comprise a substantially L shaped male extension and female recess, enabling identical panels to fit together, as shown in Figure 15.

Aspects of the present invention have been described by way of example only and it should be appreciated that modifications and additions may be

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made thereto without departing from the scope thereof as defined in the appended claims.

WHAT I CLAIM IS:

1. A construction material formed from a mixture including cement, at least one lightweight aggregate material as hereinbefore defined and an admixture; the lightweight aggregate material to cement ratio being substantially 4-10 : 1 and the admixture comprising any material(s) capable of strengthening said construction material.
2. A construction material as claimed in claim 1 wherein the admixture comprises substantially 5 - 30% of the weight of the construction material.
3. A construction material as claimed in claim 1 or 2 wherein the lightweight aggregate material substantially comprises volcanic glass.
4. A construction material as claimed in any of claims 1 - 3 wherein the admixture according to the mix required includes any one or more of the following materials: plasticiser, b-naphthalene sulphonate, aggregate sealant, reinforcing agent, wetting agent, air entrainers, foamed recycled plastics, microsilica and/or silica fume.
5. A construction material as claimed in claim 4 further including dispersant and bonding agents to assist the microsilica and/or silica fume particles to bond to the cement.
6. A construction material as claimed in any one of claims 1 - 5 wherein the ratio of lightweight aggregate to cement is 6 - 8 : 1.

7. A construction material as claimed in any of claims 1 - 6 wherein the lightweight aggregate is treated to structurally strengthen same.
8. A construction material according to claim 7 wherein the treatment comprises predrying and/or preheating.
9. A construction material as claimed in any one of claims 1-8 wherein the lightweight aggregate fines are replaced with fine sand.
10. A method of manufacturing a construction material comprising the steps of:
  - (a) premixing lightweight aggregate material as hereinbefore defined and cement
  - (b) adding admixture and sufficient water to bind
  - (c) mixing to trim
  - (d) forming into shape suitable for use in construction such as a concrete block.
11. A panel for use in masonry construction characterised in that it is precast from construction material as claimed herein.
12. A panel as claimed in claim 12 wherein it is further adapted to be vertically joined together in use, thereby forming a structure.
13. A panel as claimed in claim 11 or 12 wherein it is adapted to enable engagement with one or more panels when aligned side by side.

14. A panel as claimed in claim 13 wherein the adaptation comprises a male member extending part or all the length of one side of a panel and a female member extending part or all the length of the opposite side such that in use interlocking or engagement of same is enabled.
15. A panel as claimed in any one of claims 11 - 14 wherein it is adapted to enable engagement with one or more panels when aligned side by side.
16. A panel as claimed in claim 15 wherein the adaptation comprises a male member extending part or all the length of one side of a panel and a female member extending part or all the length of the opposite side such that in use interlocking or engagement of same is enabled.
17. A panel as claimed in any one of claims 11 - 16 wherein it may be for use in structural or non structural (as hereinbefore defined) construction.
18. A panel as claimed in any one of claims 11 - 17 wherein it is substantially rectangular in shape having protruberances from one or more surfaces thereof in an arrangement such that when two panels are aligned in use the protruberances meet, thereby forming a composite panel.
19. A panel as claimed in any one of claims 11 to 18 wherein it is of substantially solid construction.
20. A panel as claimed in claim 19 wherein it is further provided with structural reinforcing.

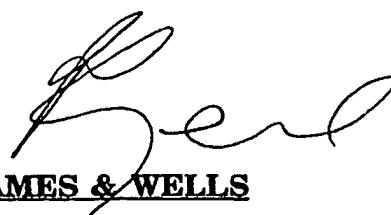
21. A panel as claimed in claim 19 or 20 wherein it is further provided with conduits therethrough.
22. A method of masonry construction comprising the steps of:
  - (a) providing a panel as claimed in any one of claims 11 - 21 and
  - (b) joining same together to form a structure.
23. A method as claimed in claim 22 wherein the method may be performed at or about the construction site.
24. A joining device for joining panels as claimed in any one of claims 11 - 21 characterised in comprising a first portion adapted to span the junction of aligned panels and secondary portions adapted to be positioned in each of the aligned panels.
25. A joining device as claimed in claim 24 wherein the first portion comprises a vertical central portion and the secondary portions comprise horizontal members extending outwardly at the base of the vertical central portion, said horizontal members being adapted to enable engagement with each aligned panel or an object in association therewith.
26. A construction material as claimed in claim 1 substantially as herein described with reference to any example thereof.
27. A method of manufacturing a construction material as claimed in claim 10 substantially as herein described with reference to any example thereof.
28. A panel as claimed in claim 11 substantially as herein described with reference to any example and/or drawing thereof.

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29. A method as claimed in claim 22 substantially as herein described with reference to any example and/or drawing thereof.
30. A joining device as claimed in claim 24 substantially as herein described with reference to any example thereof.

William Richard Milburn Farland

by his Attorneys



JAMES & WELLS

**END OF CLAIMS**

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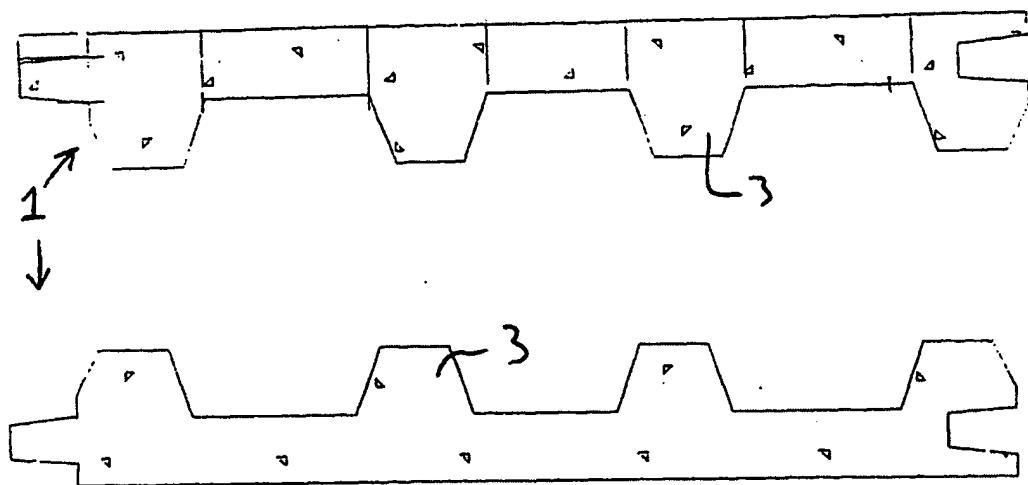


FIG 1

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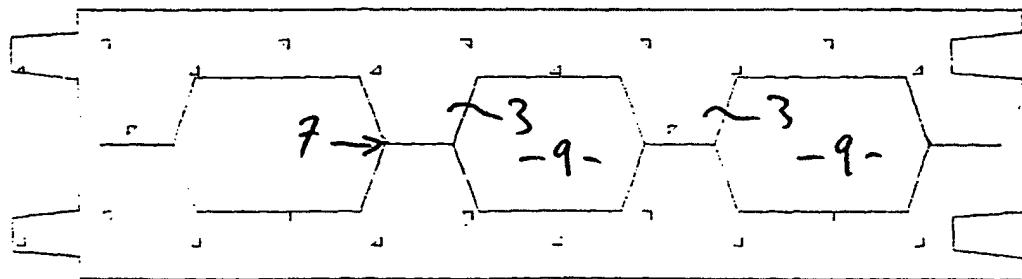
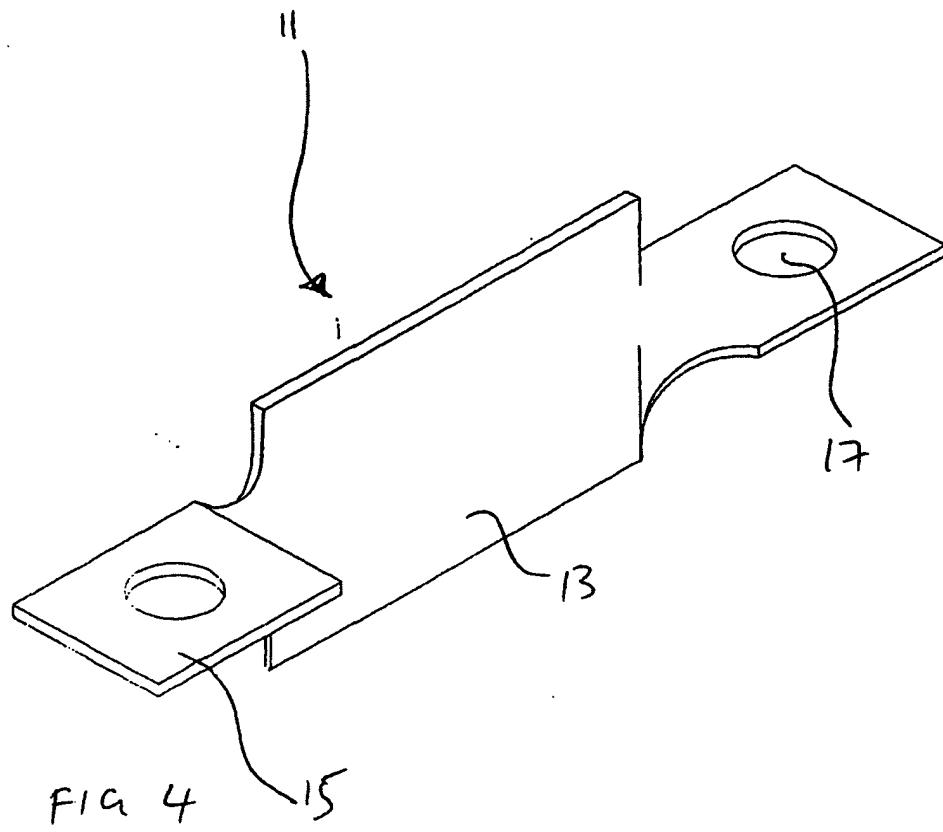
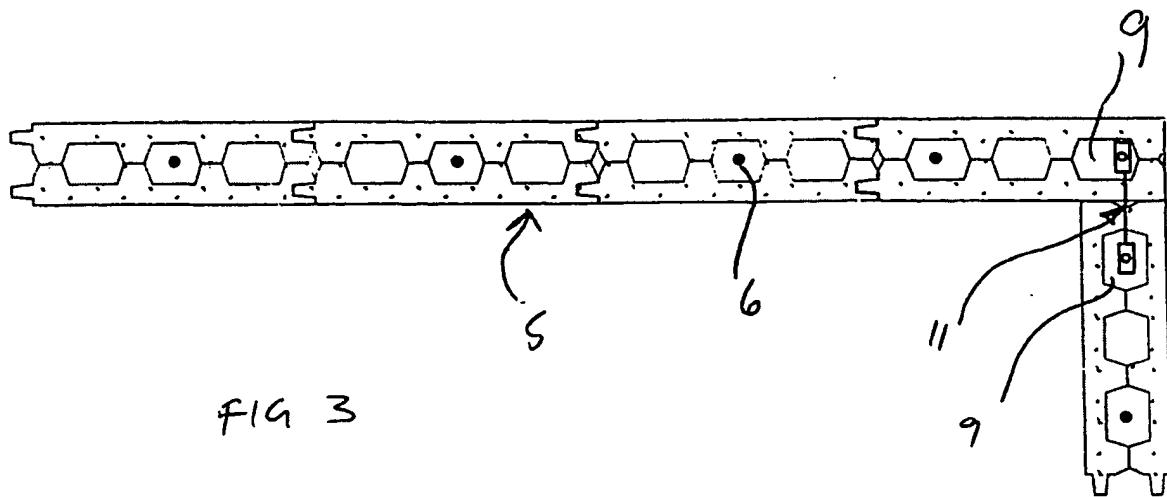


FIG 2

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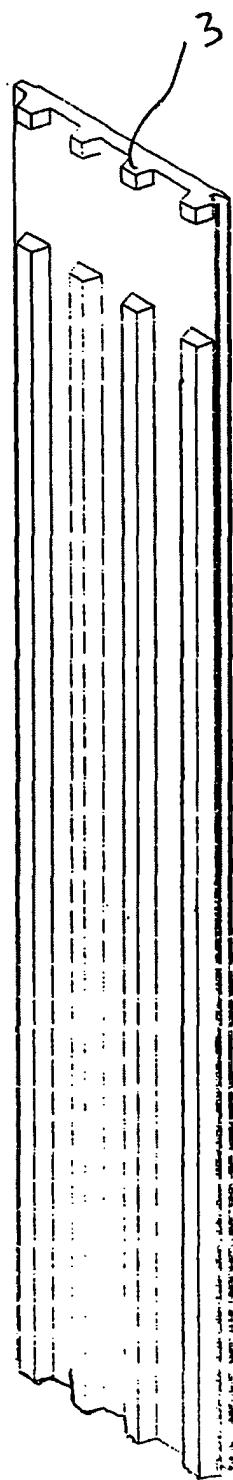


FIG 5

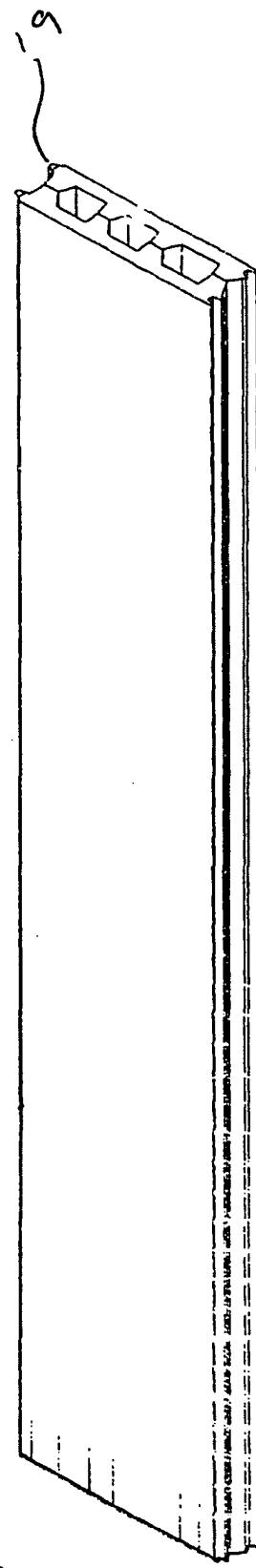
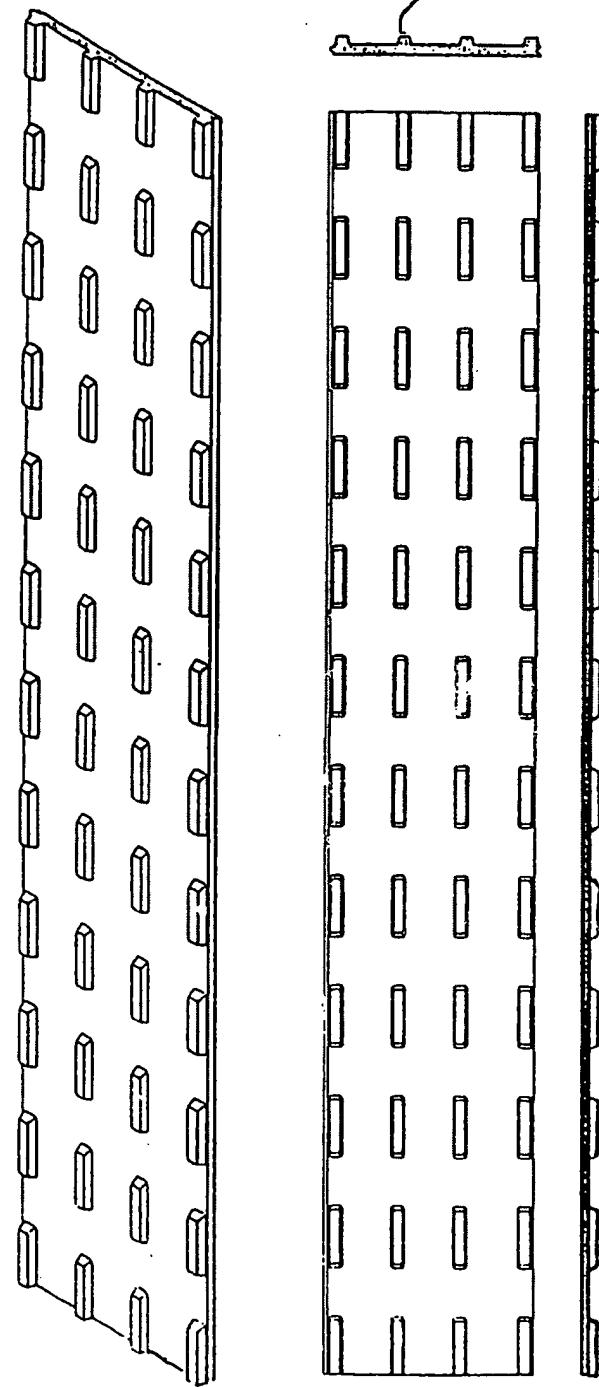


FIG 6

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FIG 7 3



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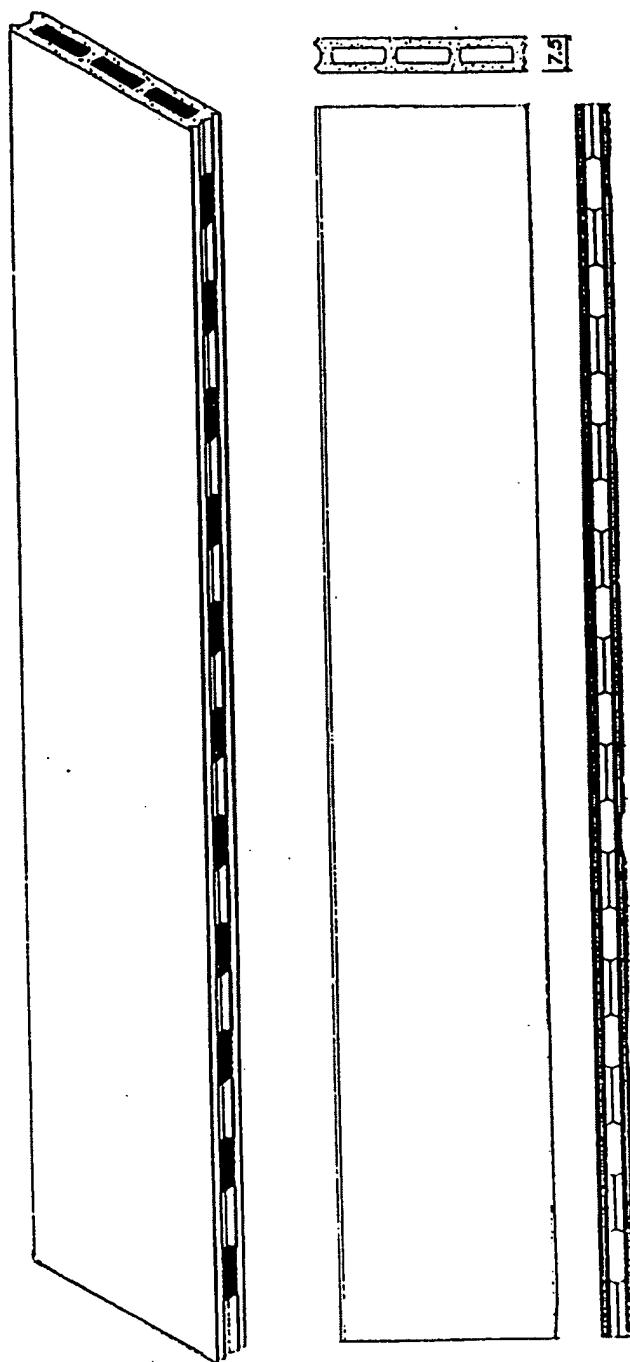


FIG 8

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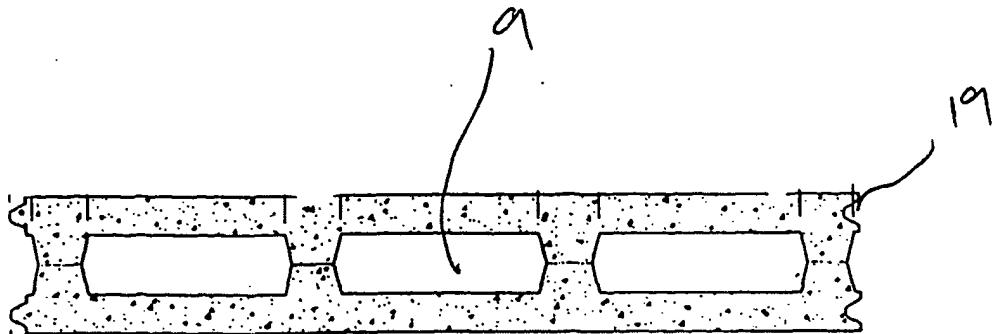


FIG 9

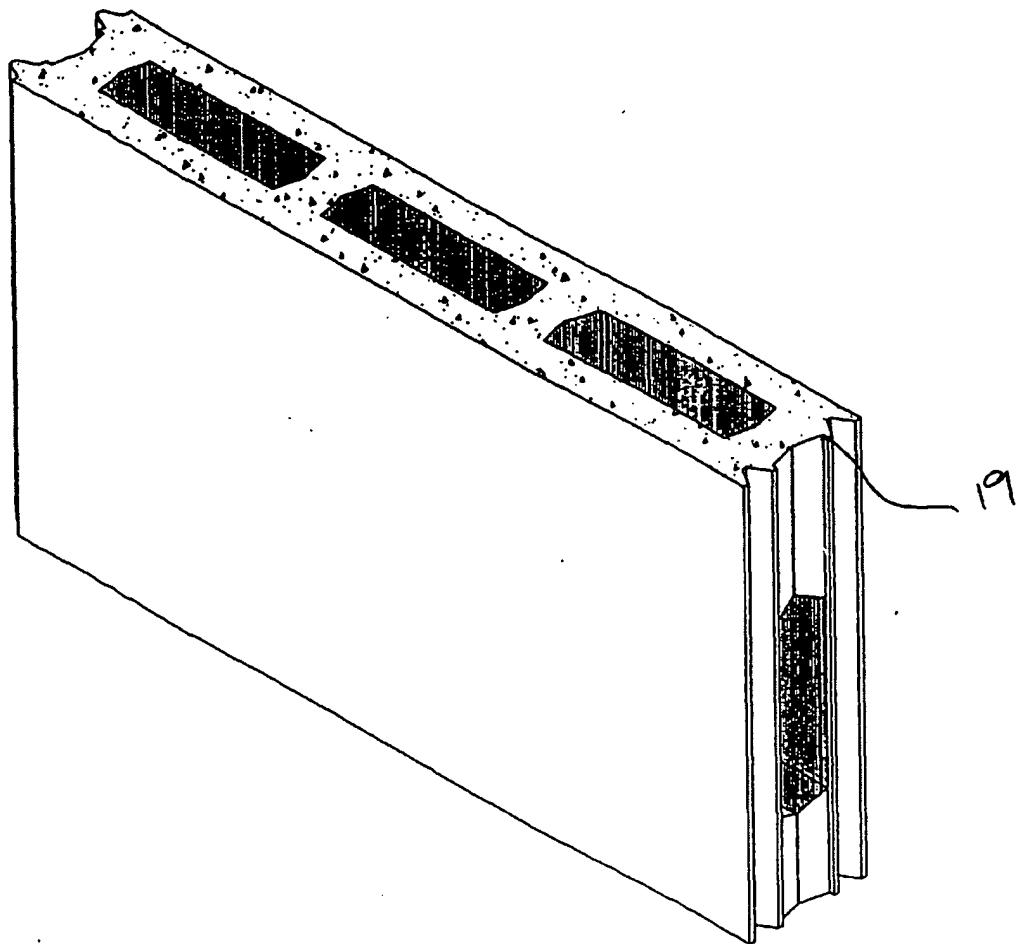


FIG 10

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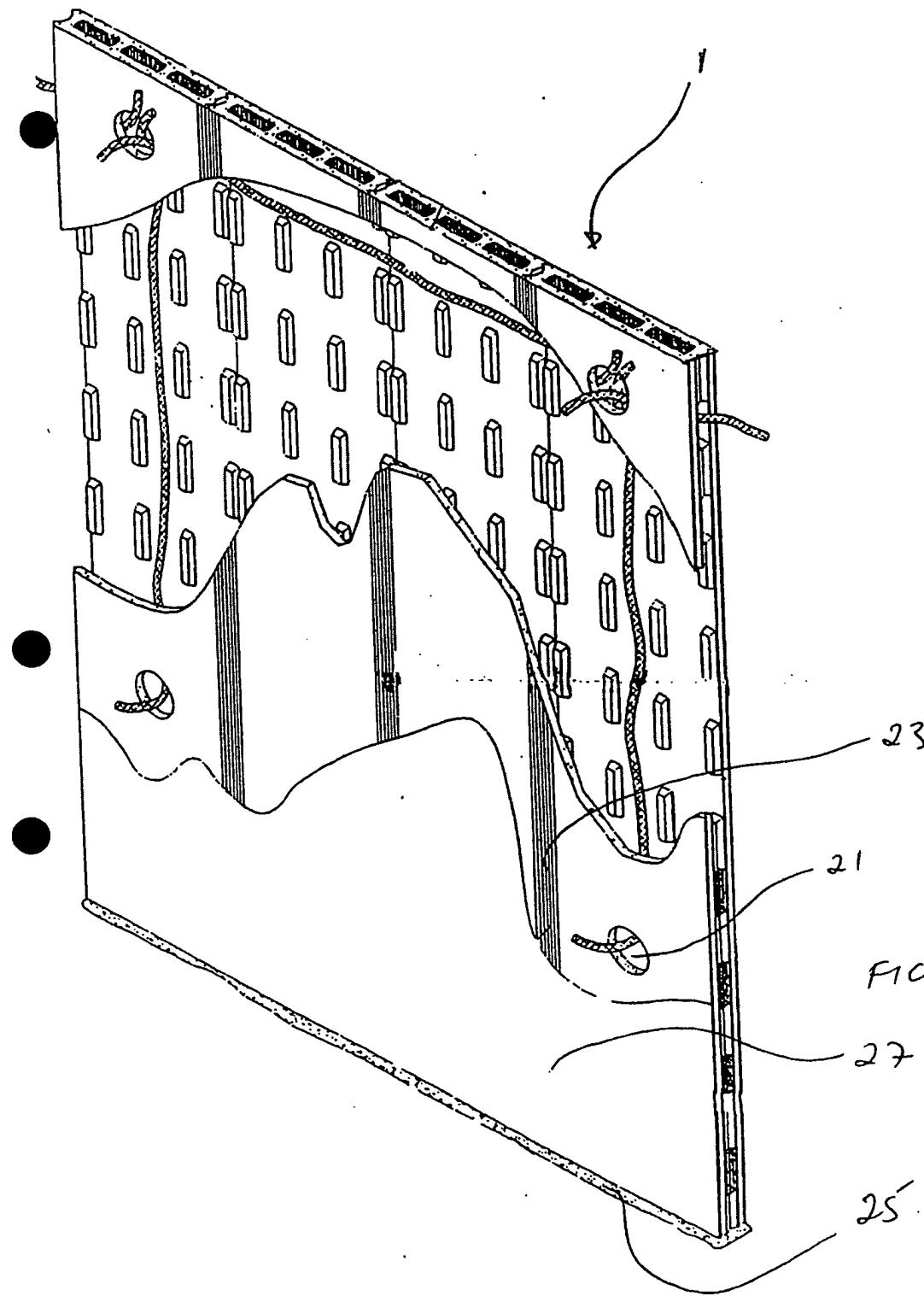


FIG 11

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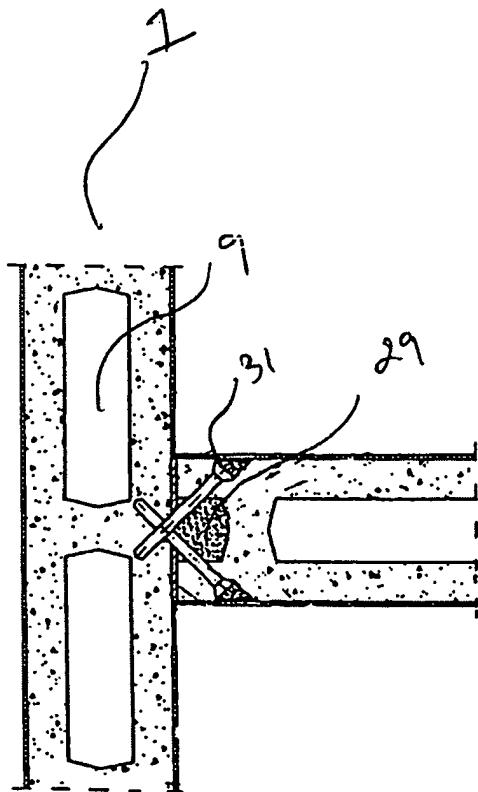


FIG. 12

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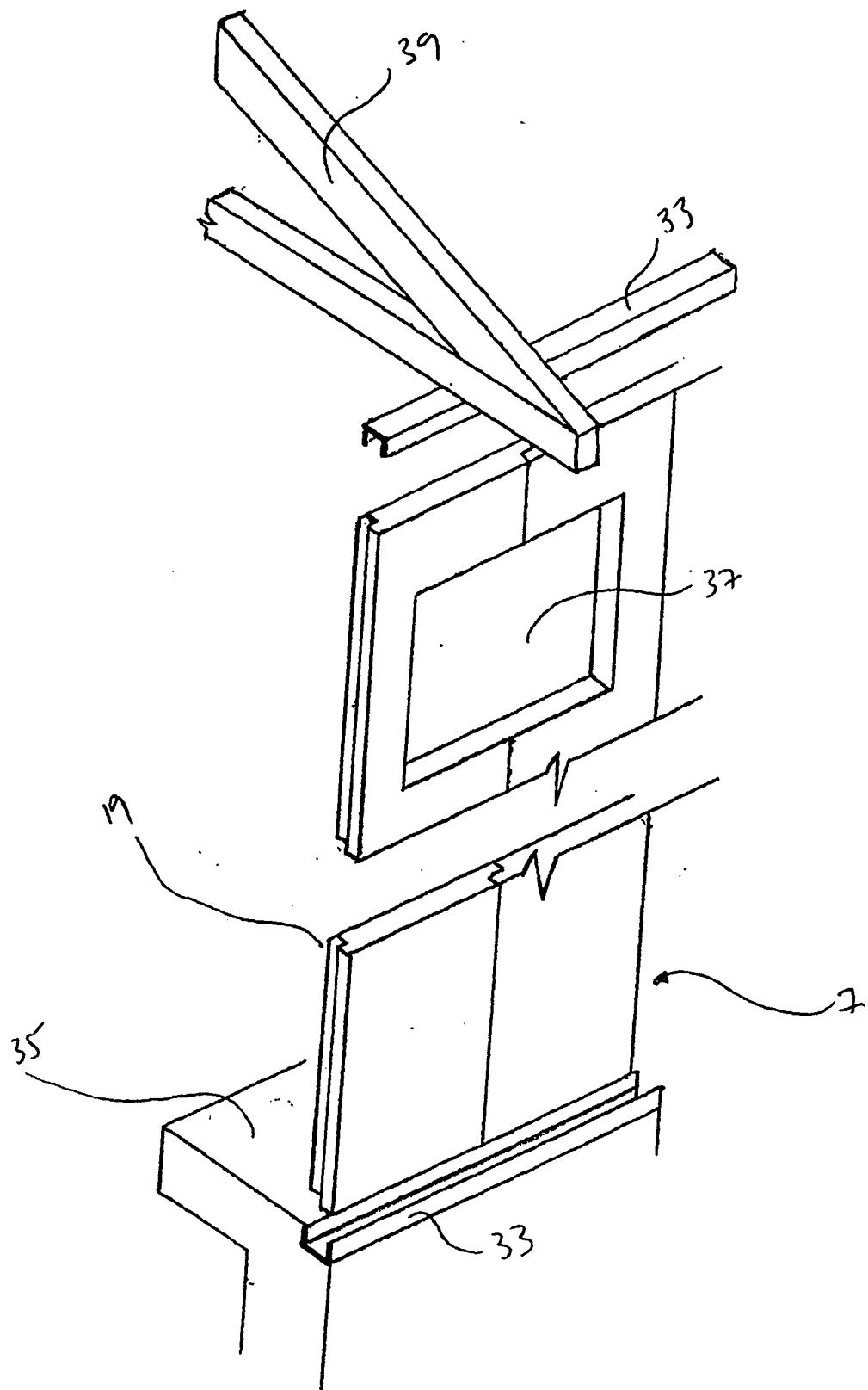


FIG 13

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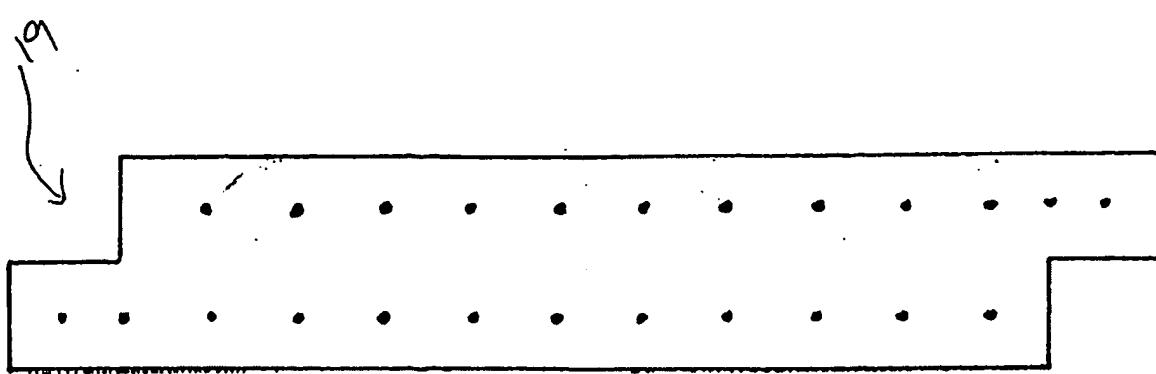


FIG 14

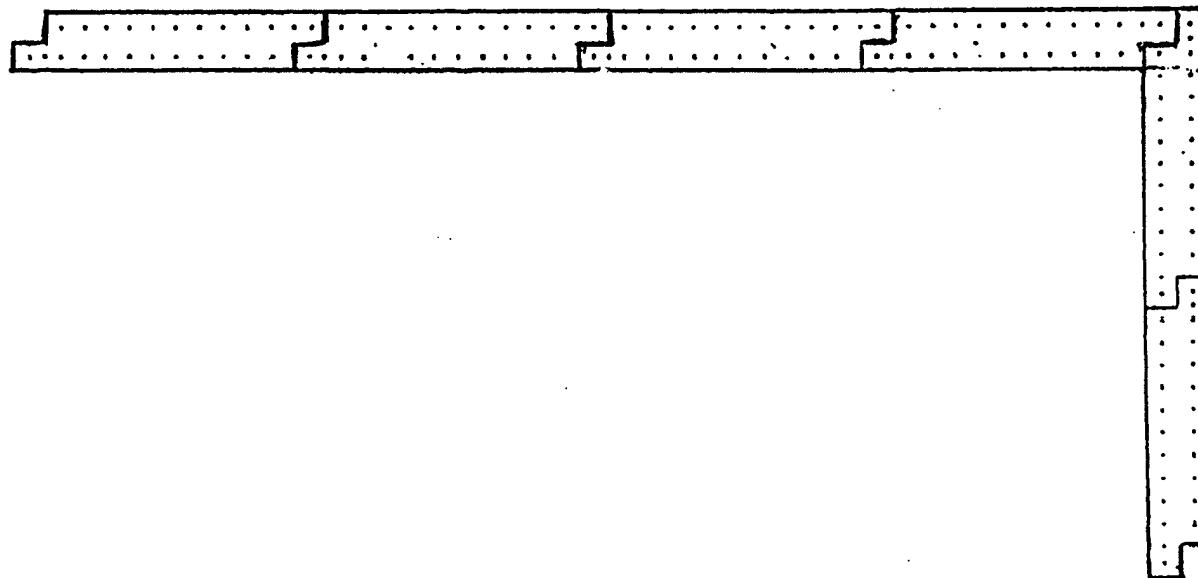


FIG 15

**END**